Climate Change: The Future Is Now / Lost Land

Summary
The lesson “Lost Land” familiarizes the students with the Dust Bowl, the current cost of soil erosion both financially and environmentally, as well as the need to preserve soil. Using stream tables, participants examine the effects of water erosion on agricultural soil.

Objectives
The students will:

- discuss two types of erosion and how climate change might increase erosion
- investigate facts about the Dust Bowl
- investigate the effects of water erosion on farmland
- design and test an erosion reduction feature

Standards

SEP1 4-ESS3-2 SL.4.4
SEP2 MS-ESS3-1 SL.5.1
SEP3 MS-ESS3-2 GO1
SEP4 MS-ESS3-4 GO2
SEP6 MS-ESS3-5 GO4
SEP7 MS-LS2-5 GO6
SEP8 4.MD.A.2 GO9
4-ESS2-1 R1.4.3
4-ESS2-2 RI.4.5

Background
100 -200 years. That’s how long it takes to make one inch of soil. Thus, soil is not a renewable resource.

Erosion is the process in which the Earth’s surface is worn away by the effects of wind and water in its various states. When water strikes the ground, it dislodges the smaller particles first. When the precipitation has surpassed the saturation point of the soil, small depressions start forming in the soil. These depressions fill with rainfall until they overflow. As they overflow, the water that flows out of them is called runoff. This runoff contains soil and whatever was in the soil. This runoff, soil and all, is then carried to a new location. This process is called deposition. Wind will pick up smaller particles first, suspending them in air, while the heavier soil particles are blown across the surface. These particles are then deposited in a new location. Erosion is a natural process, but can also be influenced by humans.

Climate changes can cause shifts in precipitation patterns. Some areas may experience more rainfall and other less. Both changes have the potential to increase the erosion of valuable farmland.

The devastating effects of the Dust Bowl of the 1930s were felt across the United States. As a result, government agencies became involved in assisting in the conservation of soil. On July 9, 1937, the Illinois Soil and Water Conservation District Act passed. It put forth the Soil and Water Conservation District's mission:

> the General Assembly declares it to be in the public interest to provide (a) for the conservation of soil, soil resources, water and water resources of the State, (b) for the control and prevention of soil erosion, (c) for the prevention of air and water pollution, and (d) for the prevention of erosion, floodwater and sediment damages and thereby to conserve natural resources, control floods, prevent impairments of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, conserve wildlife and forests, protect the tax base, protect public lands, and protect and promote health, safety and general welfare of the people of the state.

Erosion breaks down the soil's structure. Soil is no longer able to hold as much water as it used to and is easily compacted. This means there is more runoff when precipitation does occur and that plants have less moisture available to them as they grow.

From 1982 to 2007, the amount of soil erosion has decreased in the United States from 4.0 tons per cropland acre to 2.7. Many methods exist for lessening soil erosion. Different agricultural practices have been successfully implemented, such as crop rotation, tilling practices, crop and residue coverage, and strip and contour cropping. Preservation of natural vegetation and planting of vegetation are effective at controlling erosion and runoff.

Mulches will also help and allow sediments to filter through. These practices also help the soil maintain moisture, improve porosity of the soil, and help the soil maintain its nutrients.

Agricultural erosion is also expensive for farmers, society, taxpayers, and the environment. Since agricultural land value is based on productivity, a decrease in land value happens since soil becomes less productive. Costs include lost fertilizer (2.32 pounds of nitrogen and 1 pound of phosphorus per ton of eroded soil) and soil carbon, roadway ditches clogged by deposition, and increased turbidity of water that harms

organisms. Water quality is affected in a negative way. Along with these factors, as soil is being eroded and carried to a new location, any contaminants that may be in the soil and water will also be transported downhill, downwind, or downstream. Much of this silt ends up in rivers and eventually the oceans.

Erosion along coastal areas costs the United States billions of dollars each year. According to the H. John Heinz III Center for Science, Economics and the Environment, "over the next 60 years, erosion may claim one of every four houses within 500 feet of the U.S. shoreline."

Inquiry Overview
Students will first read and organize some facts about the Dust Bowl in what they think are chronological order. Next they have the opportunity to determine how two types of soil are affected by water erosion with the use of a stream table model.

Advanced Preparation
Cut apart the Dust Bowl Event strips.

Activity
- Students work in groups of four

Estimated Time
- 45 Minutes: Dust Bowl Cards
- 15 Minutes: Practice Setup of Procedure
- 60 Minutes: Testing Erosion
- 15 Minutes: Discussion & Debrief

Begin by asking students the following:

- What is erosion?
- What causes erosion?
- How might changes to the climate increase or decrease erosion?

MATERIALS
For the Class:

Student Pages	Gravel	Paper towels
Sand	Toothpicks	Water
1 Polypropylene bag	Coffee stir straws	

Each Group of Four:

1 set of Dust Bowl Event Strips
1 Cup
2 Graduated Cups
Rainmaker
1 Spoon
Model slope and catch basin
Model slope and catch basin
1 Plastic cube
2 green Chenille sticks
Scissors
Ruler

Dust Bowl Events
Give each group a set of **Dust Bowl Event** strips. Cut them apart if this has not already been done. After students have had an opportunity to read the strips aloud, challenge them to organize the strips in chronological order. Allow the group time to talk about the Dust Bowl and come up with ideas about what caused it.

As a class discussion, ask each group what they learned about the Dust Bowl, and what they think might have caused it.

Erosion Modeling
Show students the model slope, catch basin, and rain maker they will be using for this part of the activity. Explain that they will have a chance to gather data about water and its effects on soil erosion. Read through the activity together. Make sure students set up the model correctly. Assist students as they work through the activity. If you and/or your students have access to digital cameras, then the cameras would be very helpful in documenting the changes throughout this activity.

Teacher tip: Distribute sand and gravel in small cups for easier access by student groups.

Debrief
Ask the students:

- What did the catch basin represent in the model?
- Was the water which reached the catch basin clean?
- What did the water represent in the model?
- What was being eroded? How?
- What else might be in the soils that are being eroded?
- What types of problems might be caused by erosion?

Extensions

- Investigate Algal blooms
- Investigate Dead zones
- Research tumbleweed as an invasive species
    - http://ipm.ucanr.edu/PMG/PESTNOTES/pn7486.html
- Design a rainmaker that changes the amount of rain from "gentle rain " to "downpour " and repeat the activity to see how the amount of rain impacts erosion.

Resources

http://www.extension.iastate.edu/agdm/crops/html/a1-75.html
http://www.soils.wisc.edu/extension/materials/Erosion_Conservation.pdf
http://siswcds.webs.com/whatisaswcd.htm
https://www.weather.gov/oun/events-19350414-maps
http://people.oregonstate.edu/~muirp/erosion.htm

Oppedahl, David B., “Farmland Values and Credit Conditions,” AgLetter, Federal Reserve Bank of Chicago, Number 1956, May 2012.

Tegtmeier, Erin and Michael Duffy, External Costs of Agricultural Production in the United States, International Journal of Agricultural Sustainability, Vol. 2, No. 1, 2004.

USDA, 2007 Census of Agriculture

USDA/NRCS(1), Final Benefit-Cost Analysis for the Environmental Quality Incentives Program (EQIP), May 10, 2010.

USDA/NRCS(2), 2007 National Resource Inventory, Dec. 2009.